

TELKOMNIKA, Vol.11, No.3, September 2013, pp. 617–624  
ISSN: 1693-6930, accredited A by DIKTI, Decree No: 58/DIKTI/Kep/2013  
DOI: 10.12928/TELKOMNIKA.v11i3.1383

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## Utilization of Near Field Communication Technology for Loyalty Management

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### Abstrak

*Near Field Communication (NFC) adalah salah satu teknologi nirkabel yang dikembangkan saat ini. Kita dapat menggunakan ponsel untuk melakukan banyak transaksi dengan NFC. Perkembangan Ponsel telah diciptakan untuk memberikan kemudahan bagi pengguna dalam semua aspek. Namun, saat ini fungsi NFC hanya terbatas untuk pembayaran dan micropayment. Selain itu, terdapat aset yang mendukung untuk meningkatkan penjualan dengan sistem manajemen loyalitas. Dalam sistem ini, diskon atau hadiah yang diberikan berdasarkan data mining untuk setiap pelanggan yang melakukan transaksi. manajemen loyalitas ini memiliki tiga konsep, yaitu frekuensi, kekinian dan Quantity (FRQ). Tujuan dari makalah ini adalah untuk meminimalkan biaya, proses pembelian lebih cepat, dan mengelola data yang diperoleh melalui teknologi NFC lebih sederhana. Hasil dari riset ini adalah prosedur berbasis pada data mining NFC untuk manajemen loyalitas dan merancang sistem menggunakan pendekatan Bahasa Modeling.*

**Kata kunci:** Data Mining, Manajemen Loyalitas, Micropayment, NFC, Smartphone

### Abstract

*Near Field Communication (NFC) is one of wireless technology developed at this time. We can use a mobile phone to do many transactions with NFC. Mobile developments have created to provide convenience for users in all aspects. However, at this time the function of NFC just limited for payment and micropayment. Beside it, there are assets that support to increase sales with attention of loyalty management system. In this system, discounts or prizes are given based on data mining for every transaction customers. This loyalty management has three concepts. Those are Frequency, Recency and Quantity (FRQ). The goals are minimizing the cost, making purchase process faster, and managing data obtained through the NFC technology more simple. The result of this paper is the procedure to use data mining of NFC for loyalty management and designing system using Unified Modeling Language approach.*

**Keywords:** Data Mining, Loyalty Management, Micropayment, NFC, Smartphone

### 1. Introduction

The development of technology has provided convenience in all aspects. Utilization technology developments and informationsystems can be used to perform data processing transactions faster and easier for user. Several mechanisms are now widely used to transactions include Internet Online Payment, Smart Cards, Radio Frequency Identification (RFID), and Mobile Payment, where a series of mechanisms designed to facilitate users to make transactions whenever and wherever the user is located[10].

At the shopping center, the customer previously enjoys the convenience of a credit card transaction. However, Near Field Communication (NFC) has been present transaction mechanism more comfortable by using digital technology on smartphones. NFC is a short range wireless technology that is used for data exchange between devices. With NFC we can use a mobile to perform some transactions. However, the function of NFC is just limited for payment and micropayment, while in the business world is always dynamic and competitive environment. Companies need to consider it to expand their business scale by having abilities to take the right decision in determining marketing strategies in selling. One thing which has to consider is loyalty management system that related to every customer data mining.

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Received May 1, 2013; Revised July 25, 2013; Accepted August 9, 2013

In development of technology, the application of data mining has been widely used to recognize the company's customer behavior through the data collection company needs. The abundant of data that available and need for information can use as decision support to create business solutions with the infrastructure support in the field of information technology to develop their business. Discounts or prizes are given based on how often customer buy products and how much of the product purchase value in the store based on system.

## 2. Research Method

The method used is several stages of collecting literature about smart card, NFC, RFID, NFC mobile phones, Unified Modeling Language and data mining. It will be made a general design procedures micropayment system using NFC technologies, loyalty management application procedure, and design system by using use case diagrams, class diagrams and activity diagram of the procedure used.

## 3. Some technologies related

This section will explain about some technologies related with the design.

### 3.1 NFC (Near Field Communication)

Near Field Communication or NFC is a development of RFID (Radio Frequency Identification) technology that uses magnetic field induction to enable communication between electronic devices within close proximity. NFC can be used to exchange data at a distance of 10 cm at high frequency which offers data transfer speed of 106 kbit/s, 212 kbit/s and 424 kbit/s.

NFC technology is a combination between a smartcard and the reader, generally implanted within the phone. With this technology, the transaction such as payment or micropayment transactions can be performed instantly. NFC technology has three main functions:

1. NFC is able to connect with the electronic devices in a peer-to-peer network such as wireless headsets and mobile phones.
2. NFC is able to access digital content.
3. NFC can be used to perform transactions such as ticket payment, bill payment and other types of micropayment transactions.

The payment transactions in Figure 1 illustrates where NFC can change the payment transaction process to be contactless payment. The users just hold the smartphone to an NFC reader to pay or buy in a distance of less than or equal to 10 cm.

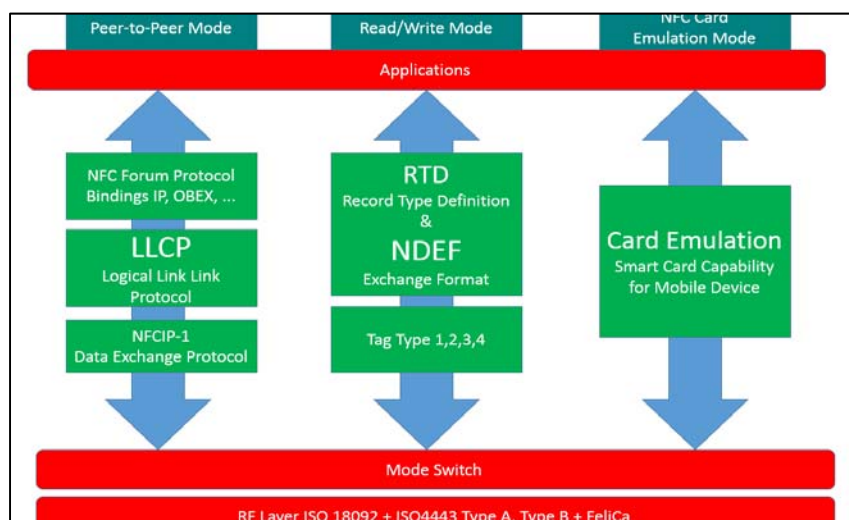


Figure 1. Architecture of NFC [1]

Figure 1 describes the architecture of NFC technology using 3 mode switches. The first mode is NFC Card Emulation Mode, where the technology has been embedded an emulation card for mobile devices. Furthermore, the device is connected to other devices with a Peer-to-Peer mode, and then transaction processing is performed by using the Read-Write mode.

### 3.2 Handphone NFC

Mobile embedded NFC chip will produce interactive services easier and more convenient to use in a payment transaction process. NFC used on mobile phones can turn into a means of payment such as credit card transactions. The mobile device has ability to store accounts like credit card number, savings account number and prepaid cards that will be used in the payment. With the highly interactive mobile, users can easily manage applications and manage users from a distance[8].

### 3.3 Smart Card

Smart card is a card made of plastic material with integrated circuit (IC). Smart card is commonly used as a credit card and a SIM card in a mobile phone. Smart card has secure storage and not easily changed, but the subsequent development of the smart card will have microprocessor and memory to support data processing and data storage. It can secure data using cryptographic or security algorithms.

Smart cards have the same size as a credit card, which on a smart card can store and process information through the electronic circuits in silicon grown on the surface of the contact type, or planted in the card and not visible from the outside for non-contact type smart cards (contactless)[9].

Smart card consists of two kinds: touch and non-touch smart cards. However, NFC is used for non-touch smart card. This card only need brought closer to card reader to complete transaction using RFID induction technology.

### 3.4 Radio-Frequency Identification (RFID)

Radio Frequency Identification (RFID) is used to describe various technologies that uses radio waves to automatically identify human or objects. RFID technology concept is similar to the bar code identification systems concept as we seen in retail stores everyday[3]. RFID tag consists of a silicon microchip and antenna. Some of the measures RFID tag can approach the size of small rice grains. The system identified radio frequency use tags attached to the object to be identified. Two-way radio transmitter-receiver sends a signal to the tag and then read the response. Generally, readers send their observations to the computer systems run the software or RFID software center[1].

Tag information is stored electronically in a non-volatile memory. The RFID tag includes a radio frequency transmitter and receiver. RFID reader sends a coded radio signal to check the tag. The tag receives the message and information responds are identified. It may just occur in tag with specific serial number, or perhaps to a product related to information such as the number of stocks, batch number, production date, or other specific information.

### 3.5 Data Mining

Data mining is a set of techniques used to automatically explore thoroughly and bring to the forefront of the complex relationships in very large data sets. The questioned data set is formed tabulated data sets as implemented in widely relational database management technology. The role of data mining is to extract interesting (non-trivial, implicit, previously unknown and potentially useful) patterns or knowledge from large amounts of data, in such a way that they can be put to use in areas such as decision support, prediction and estimation[2]. Data mining techniques can also be applied to other data representations, such as spatial data domain, text-based, and multimedia (images). Data mining can also be defined as "the modeling and discovery of hidden patterns using a large volume of data" [4].

With the database in appropriate quality and size, data mining technology has some following capabilities [4]:

1. Automated prediction of trends and behaviors: Data mining automates the process of finding predictive information in a large database. Questions that traditionally required extensive hands-on analysis can be directly answered from the data now.

2. Automated discovery of previously unknown patterns: Data mining tools sweep through databases and identify previously hidden patterns. An example of pattern discovery is the analysis of retail sales data to identify seemingly unrelated products that are often purchased together.

### 3.6 Loyalty Management

The condition of telecommunications industry business competition intensifies and the growing expectations of customers prompted company to focus on efforts to retain existing customers. In this case, a company needs to maintain existing markets through the development of customer loyalty, to maintain business and profitability.

Loyalty is the amount of consumption and frequency of purchases made by a consumer to a company. Quality of marketing consists of satisfaction, trust and commitment that has a positive relationship with loyalty. According to Kotler (2003: 140) the relationship between satisfaction and loyalty is when the consumer reaches the highest levels of satisfaction lead to strong emotional bonds and long-term commitment to the brand companies.

Loyalty is about the percentage of people who has bought in a certain time scale and made repeat purchases from the first purchase. Because of the importance of loyalty to the survival of the company, the company must continuously keep and increase the loyalty of its customers. Therefore, to build customer loyalty, companies need to have a good relationship with the customers so that the company can better understand their needs, desires and expectations.

### 3.7 Unified Modelling Language (UML)

Unified Modeling Language or UML is standard visual modeling languages that work in object oriented to specify, visualize, construct, and document the elements of the information contained in software system. UML consists of diagrams that describe the problems and solutions of the problems with a model. The diagram are common in the modeling with UML, such as Use case diagram, Activity diagram, Class diagram, Sequence diagram, Object diagram, Collaboration diagram, Statechart diagram, Component diagram, Deployment diagram. We use two types of diagram to describe the operation of the system that we have designed, the Use Case Diagram and Class Diagram[5].

Use case diagram is a diagram that describes the interaction between the actors and the system. Use case diagram describes and explains what the user needs. Use case explains "what" the system worked, not "how" the system work. Naming the use cases typically use a verb.

Class diagram describes the type of objects in the system and a variety of relationships between the objects. A class consists of objects with the same attributes, operations, relationships and semantics. Attribute is a property of an object, while the relationship is the behavior of the object. Class diagram describes the state (attributes) of a system and offers services to manipulate the situation (method)[6].

## 4. Results and Analysis

Steps of the design are as follows:

1. Making a general design procedures micropayment system using NFC technology
2. Creating Use Case Diagrams
3. Creating loyalty management application procedure
4. Creating Class Diagram to design data mining system checks loyalty management
5. Creating Activity Diagram to application of data mining and loyalty management.

### 4.1 MicropaymentProcedureusing NFC Technology

Procedures as needed to the Seller and the Customers can use the NFC in Micropayment as follows:

1. Sellers and customers already have the device to support NFC.
2. Customers must activate their personal account via sms or internet before using the NFC device.

3. Sellers also need to register with technology providers to be able to use NFC and should be willing to pay a transaction fee to the bank, payment gateway, or NFC card issuer.
4. Previously users need to have some money stored on personal accounts. Users will also be able to increase their cash via ATM, Internet, or M-Banking when their cash is run out. In this case, collaboration of technology providers and banks is required and needed to socialize.
5. When a user wants to make a transaction, users just need to position their handphone in the face of NFC reader that seller has, at a distance of 2-10 cm for about 2 seconds and enter the pin. The transaction information will be stored on a database and the user account will be reduced.
6. Furthermore, the Seller will provide a proof of transaction to the customer.

#### 4.2 Designing Use Case Diagram

Figure 2 shows a micropayment system operating with the NFC technology using Use Case Diagram:

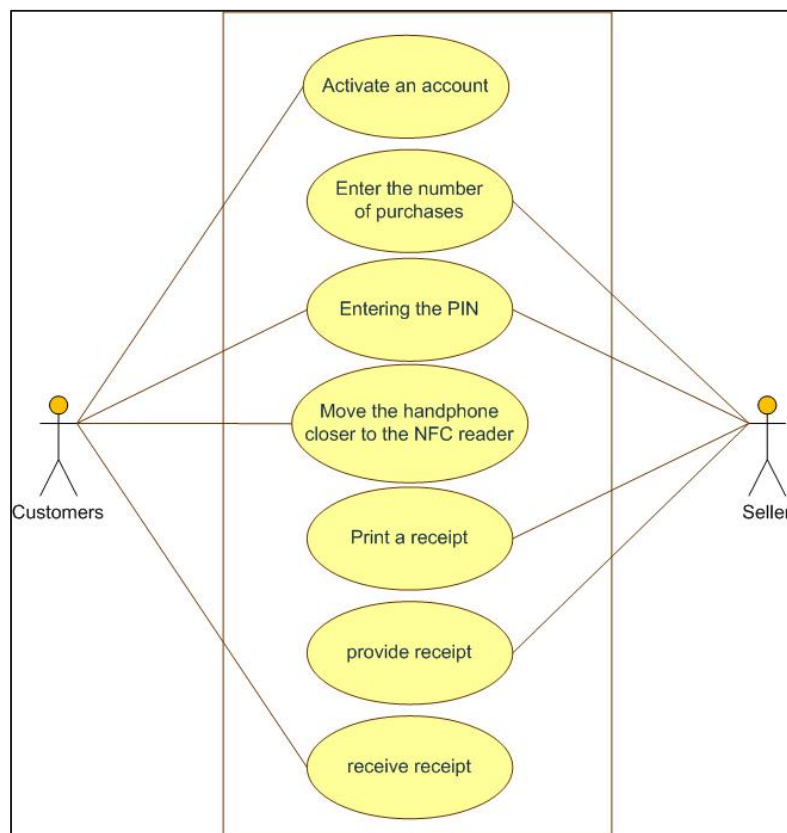


Figure 2. Use Case Diagram - Micropayment System with NFC technology

Use case in Figure 2 illustrates how the NFC technology micropayment system running. In use case diagram, there are two actors: Customer and Seller. The first thing to do is when micropayment transactions with Near Field Communication technology is committed, the seller and the customer provides the NFC and will activate the account and enter the pin to connect each other in a NFC device connection. After that, customers are asked to bring a handphone to a NFC reader. Furthermore, a receipt will be printed and will be given to the customer. Receipt is still given as proof of payment provided in real.

#### 4.3 Procedure to Apply Loyalty Management

In applying loyalty management by use NFC technology, there are some procedures required with focus utilize of data mining concepts to corporate sales. The concept used for optimizing loyalty management is the concept of Recency, Frequency, and Quantity (RFQ) [7].

This concept is often used as a marketing strategy to increase sales. RFQ concept definition is based on:

1. Recency is the dimension of the user to know when the last time a transaction made.
2. Frequency is the dimension to determine how often users perform transactions in a given period.
3. Quantity is the dimensions to determine the number of transactions made by customers.

In implementing the concept of data mining the behavior of customers over time is needed to define. This method is very useful when customers have established a pattern of behavior, so seller will know the favorite product and helps stores to apply bonuses or discounts to customers. Some of the important fields in the database that can be used for data mining process are as follows:

- a) Customer ID: indicates the user's unique identity.
- b) Customer Transaction Date and Time: shows the date and time of customer transactions.
- c) Customer Transaction Quantity: indicates nominal customer transactions done.  
Transaction Store: show where customers conduct transactions.
- d) Product Bought: indicates the product purchased by customer.

#### 4.4 Designing System Use Class Diagram

Figure 3 shows a class diagram of the design data mining system checks loyalty management:

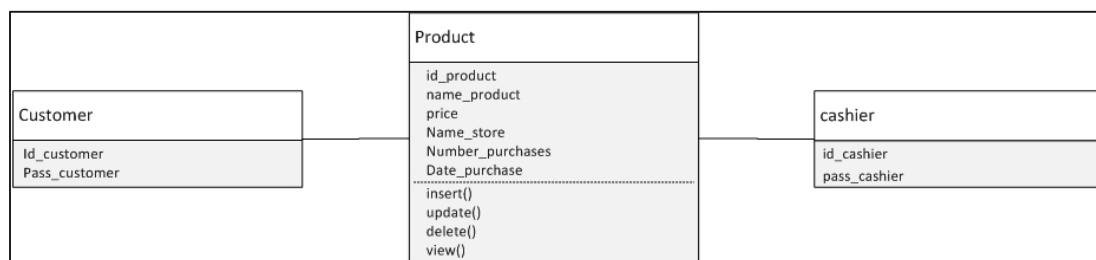


Figure 3. Class diagram - Data mining

In figure 3, there are three classes: Customer, Product and Cashier. The Customer class has attributes such as customer ID and password owned at the time of creating an account at NFC smartphone. Product class has attributes such as product id, product name, product price, name of the store where the transaction, the number of items purchased, the date of the transaction, as well as Product class also has methods of update(), insert(), delete() and view(). Last is the cashier class attributes, has id and password checkout cashier.

#### 4.5 Designing System Use Activity Diagram

Activity Diagram in Figure 4 illustrates how to start connection between the cashier and system use Data Mining resulting from the NFC technology. System will display the application home page to display the form log-in, and then the cashier will fill-in the requested data on the log-in form Data in the form of username and password. And if the log-in is successful then the system will display the PIN form filling. The next cashier will begin processing the transaction data of each customer based on the RFQ method, which will be processed in a database, whether the micropayment transaction conducted to get discounts or gifts, if a discount price, the total payments will be reduced directly in accordance with a discount obtained. After that the cashier will print a receipt of payment, which will be given to the Customer and retained by the cashier as a form of documentation in real.

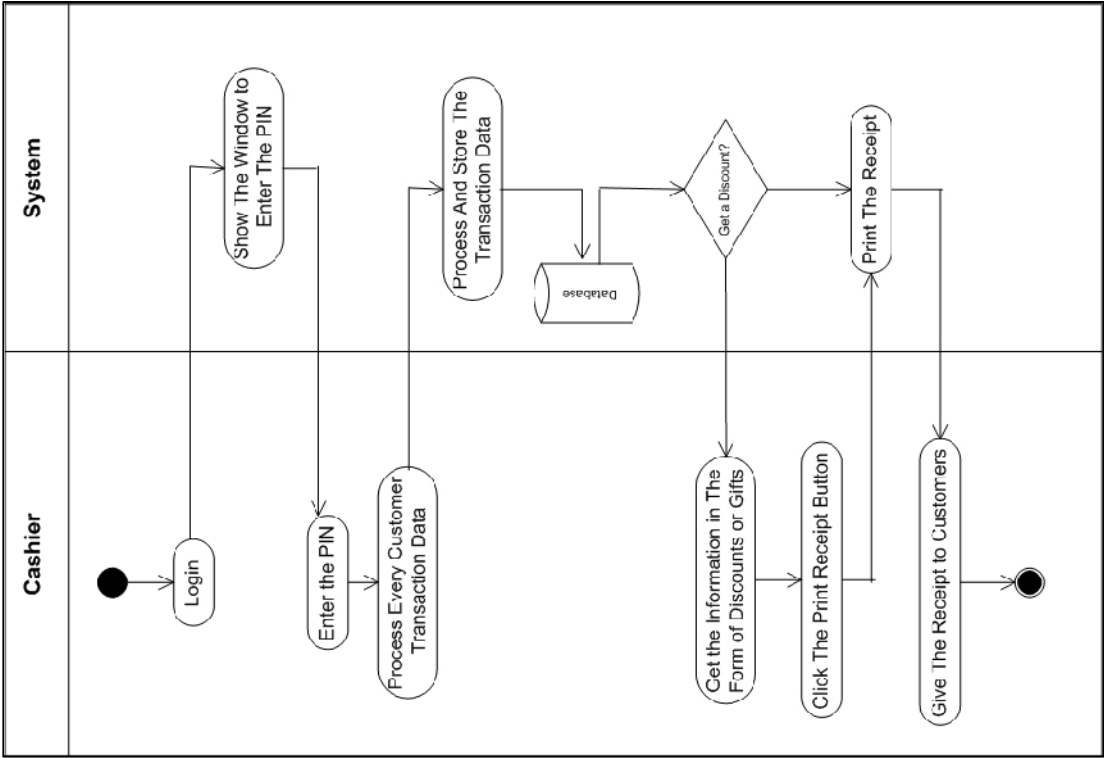


Figure 4. Activity diagram – System to apply Data Mining

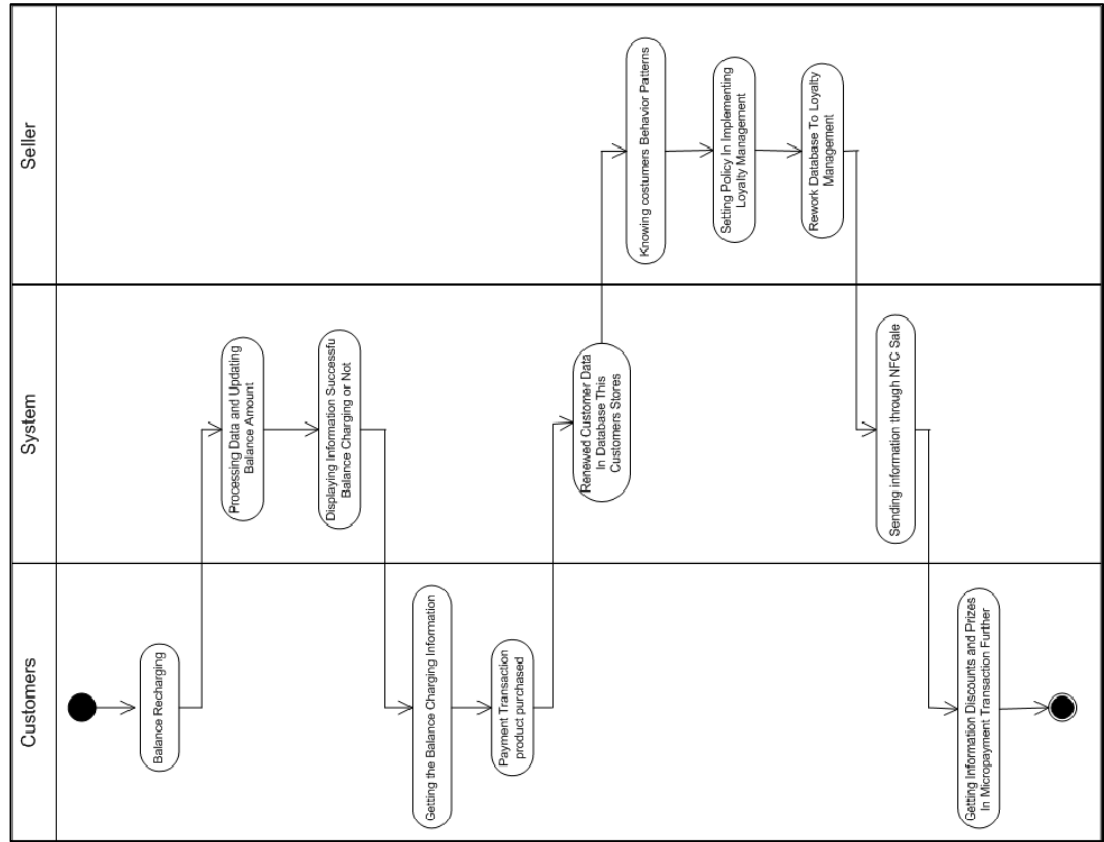


Figure 5. Activity diagram –System to Apply Loyalty Management

Activity Diagram in Figure 5 illustrates the application of loyalty management system involving customers, System and Customer. To make a micropayment transaction, customer must have a balance on the NFC account. If the customer wants to increase the balance, customer can top-up in that store and will be processed by the system to the customer to get information about charging her account balance NFC successfully. After that, micropayment transaction process can be carried out with the involvement of the renewal process database that contains fields identified as a benchmark in loyalty management application. By looking at the frequent that customers intensity micropayment transactions in the store, so the store can determine patterns of behavior or product to the favorite customer. Next, the cashier or store can set policies to implement loyalty management, as a marketing technique. For the next transactions when Customer purchase products in store, the discount or gift information obtained will be shipped to the NFC customer and the price will be reduced directly.

## 5. Conclusion

The design of loyalty management application system used three types of diagrams in UML modeling. There are two actors involved: customer and seller. The NFC technology for loyalty management is a step in utilizing of data mining micropayment transactions in order to provide convenience for the seller in implementing the provision of bonuses and discounts to keep the store business and profitability. The systems and procedures in this study are expected to process payment transactions done more quickly, easily and securely. The data accuracy is expected in implementing loyalty management based on utilizing data mining of customer behavior pattern toward the purchase of products everytime more efficient. This proposed concept must be more explored.

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